

A Plan to Gain Public Support for Native Trout Restoration by Improving Sport Fishing

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Abstract — Efforts to conserve native trout in Utah have often been controversial. Local governments, resource managers, special interest groups, and anglers have expressed concern over the consequences of **expanding** populations of any species which could be potentially listed under the Endangered Species Act. The **concerns** of governments, managers, and organized groups have been addressed through their inclusion in work groups which have developed formal conservation agreements, completed plans to satisfy state law, and conducted National Environmental Policy Act processes. The general angling public has, for the most part, not been highly involved in planning efforts and **is often** apprehensive when native trout conservation projects are proposed. Anglers often view such projects as conflicting with popular sport fisheries for nonnative trout. Because public support is essential to continued conservation efforts, a strategic plan to build angler support should be a part of any conservation plan or recovery effort. In southern Utah, that plan includes the use of native trout to improve sport fisheries in areas which presently contain poor fisheries for nonnative brook trout (*Salvelinus fontinalis*). Between 1969 and 1982, rotenone was used to eliminate stunted brook trout from **three** lakes on Boulder Mountain. These waters were subsequently stocked with nonnative cutthroat trout, with a resulting increase in the mean size of trout available to anglers. Similar projects are planned at as many as 16 waters in southern Utah where fisheries of stunted brook trout will be replaced with locally native Bonneville and Colorado River cutthroat trout (*Oncorhynchus clarki utah* and *O. c. pleuriticus*, respectively), which are now available from wild brood stocks.

INTRODUCTION

Fishery managers in western states are faced with the **dilemma** of maintaining sport fishing recreation for popular nonnative trout while at the same time conserving and expanding native cutthroat trout populations in an attempt to prevent the need to federally list these subspecies under the Endangered Species Act (ESA). These objectives can be in conflict when the **fishing** public perceives that popular sport fisheries are being jeopardized by native trout restoration projects. Within southern Utah, sport fish **conflicts** on restoration projects for Bonneville and Colorado River cutthroat trout (*Oncorhynchus clarki*

utah and *O. c. pleuriticus*, respectively) conducted over the past 24 years were largely avoided by restricting projects to **small** isolated streams where little fishing pressure **occurred**. Nevertheless, as restoration programs have grown, become more publicized, and expanded into larger drainages that contain popular sport fisheries, the potential for **con-** flict has increased. Conflicts have been minimized with local **governments**, land management agencies, and organized groups by the inclusion of these groups in the development of State plans, Conservation Agreements, and National Environmental Policy Act (NEPA) processes as they pertain to native trout, **but** the majority of anglers **are not** involved in such efforts and some anglers remain apprehensive.

Future success and direction of native trout restoration projects will be largely dependent on public support. Fishery management plans for the Boulder Mountain, in south-central Utah, include the use of

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native trout to improve fishing in small lakes and thereby gain support and credibility with sport fish anglers. Approximately 80 small lakes, reservoirs, and ponds are managed as sport fisheries on the Boulder Mountain, many of which provide exceptional fishing for brook trout (*Salvelinus fontinalis*). Up to 16 of these lakes and ponds, however, are being considered for renovation where stunted brook trout have failed to provide acceptable levels of sport fishing. The plan is intended to improve sport fishing on Boulder Mountain without impacting popular sport fishing waters, and includes the expanded use of native trouts as a secondary benefit. The purpose of this paper is to describe the plan, including the affected resource and expected benefits, particularly as it applies to native cutthroat trout.

PROJECT AREA

The Boulder Mountain, technically named the Aquarius Plateau on U.S. Geological survey maps, includes headwaters of the Fremont River drainage on its north and east slopes, the Escalante River drainage on the south and east slopes, and a small portion of the East Fork Sevier River drainage on the west slope. The project area includes the Teasdale and Escalante Ranger districts of the Dixie National Forest. Colorado River cutthroat trout are native to the Fremont and Escalante River drainage and Bonneville cutthroat trout are native to the Sevier River drainage. Remnant populations of Colorado River cutthroat trout are found in five isolated headwater tributaries to the Escalante River drainage on the Boulder Mountain (Hepworth et al. in press). One remnant population of Bonneville cutthroat trout is located on Boulder Mountain in the East Fork Sevier River drainage (Hepworth et al. 1997), and no remnant populations of native cutthroat trout are presently known from the Fremont River drainage on Boulder Mountain.

Geologically, Boulder Mountain is a relatively productive basalt and sandstone formation that extends to elevation over 3350 m (msl). Numerous lakes and ponds, generally < 24 ha in size are found both on top of the plateau and around the mountain just under the rim of the plateau. Sport fisheries have been developed in many of these waters as well as in a number of small irrigation storage reservoirs that

were constructed 40-60 years ago. Because of the general remoteness of the location, the plateau was not explored until 1872 and the Escalante River was noted as the last large river drainage added to the map of the continental United States (Stegner 1954). Stocking of nonnative trouts was first recorded in the 1940s and sport fishing thereafter became popular. Many remote lakes were first stocked by pack horse or airplane, which are still the primary means of stocking many of these lakes today.

Despite introductions of rainbow trout (*O. mykiss*), brown trout (*Salmo trutta*), and nonnative cutthroat trout (primarily the Yellowstone subspecies *O. c. bouvieri*), Boulder Mountain is most notable for its exceptional brook trout fishing. Brook trout in the 0.7 to 1.4 kg range are common, and some brook trout in excess of 2.3 kg are harvested almost every year. Boulder Mountain lakes are generally more productive than many other alpine lakes, especially those in granitic formations. When fingerling-size (> 75 mm) brook trout are stocked at the rate of 125 fish per ha, growth can exceed an average of 0.5 kg per fish in a year, with some fish exceeding 2.0 kg by the third summer (surviving two winters). Mean condition (K) for brook trout populations can exceed 1.3. Brook trout are often larger than other nonnative trouts, including cutthroat trout within the same lake. The Utah state record brook trout is a 3.4 kg fish caught on Boulder Mountain in 1971.

Although brook trout have been successful in many Boulder Mountain locations, they have over-populated in some waters and stunted. Natural reproduction has been so extensive in some lakes that brook trout do not exceed a total length (TL) of 260 mm, and in some lakes brook trout have a mean condition factor as low as 0.86. At least nine rotenone treatment projects have been conducted on Boulder Mountain lakes containing stunted brook trout populations between 1969 and 1984 (Table 1).

Treatment projects either temporarily reduced brook trout numbers and improved growth, or allowed complete replacement of brook trout with nonnative cutthroat trout. Because cutthroat trout reproduced to a lesser extent than brook trout (or were stocked in controlled numbers) and because of the general high productivity of the lakes, restored fisheries produced larger trout than under pre-treatment conditions. Increased recreation occurred after treatment at all renovated lakes.

Table 1. —Waters treated for stunted brook trout on Boulder Mountain and results, 1969-1984. Results: Complete **kill** = eradication of all brook trout successful; Incomplete **kill** = eradication of all brook trout unsuccessful; Planned **partial kill** = no attempt made to remove all brook trout.

Water	Year	Results	Comments
Crescent Lake	1969	Complete kill	Good fishing to present for cutthroat trout.
Fish Creek Res	1970	Incomplete kill	Good fishing for about 3 years for brook trout.
Beaver Dam Res	1970	Planned partial kill	Good fishing for about 10 years for brook trout.
Round Willow Res	1971	Incomplete kill	Good fishing for about 3 years for brook trout.
Oak Creek Res	1973	Complete kill	Good fishing to present. *
Short Lake	1982	Incomplete kill	Good fishing for about 3 years for brook trout.
Moseman Lake	1982	Complete kill	Good fishing to present for cutthroat trout.
Fish Creek Res	1984	Planned partial kill	Good fishing for about 3 years for brook trout.
Beaver Dam Res	1984	Planned partial kill	Declining but good fishing to present for brook trout.

* Good fishing until about 1990 for cutthroat trout but brook trout were afterwards found in the reservoir, possibly from an incorrect aerial fish stocking, and the fishery is now declining.

METHODS USED TO DEVELOP THE PROJECT

Public involvement in the proposed Boulder Mountain project occurred from its inception. Part of formal public oversight of the Utah Division of Wildlife Resources (UDWR) includes five Regional Wildlife Advisory Councils (RAC), each representing a different geographic area and composed of 13 private citizens representing diverse segments of public interest. The proposed fishery management plan for the Boulder Mountain was initiated as a result of public comments made at a 1998 southern RAC meeting. Concerns were expressed about perceived increases in fishing pressure and declines in quality of fishing on Boulder Mountain. The southern RAC advised UDWR to study the situation for a year and make recommendations. At the 1999 southern RAC meeting UDWR made a recommendation to develop a plan to renovate stunted brook trout fisheries on Boulder Mountain, and at the 2000 meeting the formal plan was approved by the southern RAC.

Because the project area is within national forest lands, NEPA processes were enacted to allow review and approval of chemical rotenone treatments and construction of fish migration barriers. The NEPA process was conducted during 2000 along with state review processes and included publication of legal notices in local newspapers, mailing of over 600

letters to potentially interested parties, key contacts with local county commissioners, and eventual writing and public review of an Environmental Analysis (EA; Chamberlain 2000). Public attention also was drawn to the EA by articles in local and state-wide newspapers, magazines, and radio shows.

The EA included plans to treat up to 18 lakes over a 6-year period starting in fall 2001. Two-four lakes are planned to be treated per year. Lakes are scheduled to be treated twice (once a year on consecutive years) to increase the probability of complete removal of brook trout. Several of the lakes in the plan presently offer marginal fishing. Two of the marginal lakes have been treated in the past and have since provided good fishing, but condition and size of brook trout has declined and is expected to get worse as overall number of brook trout continue to increase. Waters which are currently providing some sport fishing are scheduled for treatment near the end of the 6-year period, and will only be treated if existing fisheries decline to an unacceptable condition (generally when maximum brook trout length does not exceed 290 mm TL or mean condition is < 1.00).

To determine which lakes should be included in the plan, most brook trout fisheries on Boulder Mountain thought to contain stunted fish or marginal fisheries were surveyed during 1999 (Table 2). For comparison, a number of other lakes with more popu-

Table 2— Brook trout **statistics**, sport fish status, and management **classification** of waters surveyed **during 1999**. Status: Stunted = $K_{TL} < 1.0$ or maximum length < 290 mm **TL**; Marginal = $K_{TL} > 0.99$ and < 1.15 or maximum length < 360 mm **TL**; Quality = $K_{TL} > 1.14$ and maximum length > 359 mm **TL**. Management classification: Conservation population = **CP**; Sport fish population = **SF**.

Lake, reservoir, or pond	Area (ha)	Number fish in sample	Hours gill-netted (number nets)	Mean length (mm) (range)	Mean weight (g)	K_{TL}	Source of trout (wild or stocked)	Status and Classification
Bear Creek Pond	0.7	54	2.0 (1)	271 (206-352)	210	1.01	Wild	Marginal SF
Beaver Dam Res	5.4	56	18.5 (1)	307 (200-461)	341	1.10	Wild	Marginal *1 SF
Blue Lake (GT)	2.8	23	22.0 (1)	281 (174-327)	228	1.00	Stocked	Marginal SF
Blue Lake (NC)	0.6	30	1.3 (1)	226 (191-279)	100	0.87	Wild	Stunted *1 SF
Bullberry Lake #1	0.2	15	1.3 (1)	239 (183-287)	153	1.06	Wild	Stunted *2 SF
Bullberry Lake #4	0.4	16	1.0 (1)	227 (199-261)	102	0.86	Wild	Stunted *2 SF
Chuck Lake	2.1	27	18.0 (1)	259 (223-295)	223	1.26	Stocked	Marginal SF
Cooks Lake	4.6	13	16.0 (1)	246 (189-320)	166	1.02	Stocked	Marginal SF
Donkey Lake	9.3	99	19.0 (1)	260 (155-354)	221	1.05	Wild	Marginal *1 SF
Fish Creek Res	10.4	30	2.3 (1)	270 (171-305)	177	0.88	Wild	Stunted *1 SF
Heart Lake (N)	0.2	18	1.0 (1)	239 (193-273)	129	0.93	Wild	Stunted *1 SF
Heart Lake (S)	0.1	22	1.0 (1)	219 (163-254)	103	0.97	Wild	Stunted *1 SF
Joe Lay Res	1.4	28	18.0 (1)	281 (193-425)	266	1.20	Stocked	Quality SF
McGath Lake	19.2	16	18.0 (1)	390 (221-490)	779	1.36	Stocked	Quality SF
Oak Creek Res	15.0	62	14.0 (2)	326 (188-410)	439	1.14	Wild	Marginal *1 SF
Pacer Lake	8.3	55	13.5 (2)	320 (230-435)	456	1.28	Stocked	Quality SF
Pine Creek Res	1.3	96	21.0 (1)	246 (159-335)	164	0.97	Wild	Stunted *1 CP
Purple Lake	5.8	36	18.0 (1)	307 (235-380)	315	1.02	Stocked	Marginal SF
Raft Lake	5.4	14	20.0 (1)	318 (235-365)	420	1.22	Stocked	Quality SF
Rob's Res	0.8	30	1.3 (1)	249 (189-297)	151	0.95	Wild	Stunted *1 CP
Round Willow Res	3.4	47	2.0 (1)	222 (202-289)	97	0.89	Wild	Stunted *2 CP
Short Lake	0.7	30	2.0 (1)	239 (152-282)	145	1.01	Wild	Stunted *1 SF
Solitaire Lake	1.9	34	1.0 (1)	237 (211-257)	117	0.87	Wild	Stunted *1 SF
Surveyors Lake	1.7	23	19.0 (1)	280 (203-341)	238	1.03	Stocked	Marginal SF
Tall Four Lake	0.3	21	12.0 (1)	295 (147-403)	444	1.23	Wild	Quality CP

*1. Water considered for treatment to remove wild brook trout population.

*2. Water considered for treatment to remove wild brook trout population along with interconnected pond or reservoir not listed in survey.

lar brook trout fisheries also were surveyed. Trout populations were sampled in 26 lakes using experimental gill nets. An attempt was made to capture at least 30 fish per lake and record TL, weight, and condition for each fish. At the smaller Heart and **Bullberry** lakes where a series of ponds were **interconnected**, samples were combined among ponds for a total of 30 fish. At Tall Four Lake the sample was

limited to 21 brook trout because of its development for brood stock of native cutthroat trout. Data on brook trout size and condition were used to **rank** waters and list their status as stunted, marginal, or quality. In addition, physical data on lake **area**, depth, and volume was measured, and information was collected on lake inflows and outflows, the **presence** of other fish species besides brook trout, **occur-**

rence of natural fish migration barriers, and connectivity of streams and lakes. Physical data were used to determine the feasibility of treatment projects and the extent to which lakes and connected streams should be treated. Lakes where treatments were feasible were classified in regard to native cutthroat trout restoration as either "conservation populations" or "sport fish populations" (Lentsch et al. 1997, Lentsch and Converse 1997). Conservation populations are managed specifically for preservation of the species, but not usually to the exclusion of sport fishing, while sport fish populations of native cutthroat trout are maintained by stocking.

Streams proposed for treatment and analyzed in the EA included sections associated with lakes where brook trout need to be completely removed to prevent these lakes from being repopulated, and which will be important for natural recruitment of native trout. Fish migration barriers will be constructed at several sites to prevent brook trout or other nonnative trout from gaining access back into treated areas and to expand areas where native trout can be re-established. Migration barriers will be constructed from local rocks and boulders to form falls of 1.5 to 2.5 m that will prevent upstream movement of fish.

FISHERY MANAGEMENT PLANS

Cutthroat trout will be restocked into treated waters from a locally native brood stock of Colorado River cutthroat trout developed at Dougherty Basin Lake (located on Boulder Mountain; Hepworth et al. 2000a) and a native brood stock of Bonneville cutthroat trout developed at Manning Meadow Reservoir (located in southern Utah; Hepworth et al. 2000b). The appropriate subspecies will be stocked into its native range depending on whether treated waters are located in either the Colorado River or Bonneville basin. Colorado River cutthroat trout will be used most extensively because all project waters except one lake and stream are within the Colorado River basin.

Classifying lakes as "conservation populations" was based on the availability of spawning habitat and lake connectivity to streams capable of sustaining cutthroat trout populations. Of the 18 lakes considered candidates for treatment, four are planned to be managed as conservation populations for native cutthroat trout (Table 2). These include Round and Long Willow Bottoms reservoirs at the head of Twitchell Creek in the Escalante River drainage (Colo-

rado River cutthroat trout), Pine Creek Reservoir at the head of Pine Creek in the Fremont River drainage (Colorado River cutthroat trout), and Robs Reservoir at the head of Center Creek in the East Fork Sevier River drainage (Bonneville cutthroat trout). In addition, conservation populations will include about 27 km of renovated streams (6.8, 12.1, and 8.5 km of Twitchell, Pine, and Center creeks, respectively). Natural barriers will prevent movement of nonnative trout back into Center Creek and part of Twitchell Creek. Construction of an additional barrier on Twitchell Creek will nearly double the length of this stream managed exclusively for native trout. Construction of a barrier upstream from a de-watered section of Pine Creek will prevent upstream movement of nonnative trout into this stream during non-irrigation periods of the year when stream flows are seasonally restored.

Several additional lakes in the plan (such as Short Lake and Blue Lake NC, Table 2) could support self-sustaining populations of native Colorado River cutthroat trout if habitat improvements were made to establish spawning areas. These lakes will be stocked with Colorado River cutthroat trout, or sterile hybrid tiger trout (female brown trout x male brook trout) and splake (female lake trout *S. namaycush* x male brook trout), allowing this option for future consideration.

The remainder of the renovated lakes will not likely support self-sustaining populations of wild trout (aside from brook trout) and are planned to be periodically stocked as needed with fingerling-size Colorado River cutthroat trout or tiger trout, splake, and rainbow trout to maintain sport fisheries. The sport fishing benefits of using native trout in appropriate waters will be evident by improved fishing compared to pretreatment conditions. Tiger trout and splake have some characteristics similar to brook trout, will offer variety, and can be managed by stocking without over-crowding or hybridizing with native fishes. Rainbow trout will be stocked as a last option in areas where they will not threaten native trout and if other species are not available.

DISCUSSION

Overall, support for the project among anglers has been mixed with some fishermen expressing a desire for expanded use of native cutthroat trout and others indicating a continued preference for brook trout. The majority of anglers have expressed little opinion,

but some anglers do not believe that lake renovations will be restricted to stunted brook trout populations and feel that even the best brook trout fisheries might be treated. Public scepticism exists over use of native cutthroat trout because of their "sensitive" status and potential for listing under the ESA. Some anglers fear that **increased** stocking of native cutthroat trout into new areas will result in additional land management restrictions, including reductions in sport fishing opportunities with more regulatory closures and special rules.

An important objective of the plan for Boulder Mountain is to eventually dispel angler concerns about native trout by using native fish to improve fishing, and at the same time maintain other popular fisheries for nonnative trout. The unique appearance of Colorado River cutthroat trout should help promote their use and popularity. Local fishermen are not generally familiar with Colorado River cutthroat trout because of their scarcity during the last half of the twentieth century. Anglers are more familiar with nonnative trouts, including nonnative cutthroat trout that have been widely introduced. Colorado River cutthroat trout are more **colorful** than most other subspecies of cutthroat trout (**Behnke 1992**), with larger and older males typically **displaying** brilliant orange and red ventral regions that extend from the slash marks under the jaw posterior to the anal **fin**. Increased interest among fisherman has already become evident in a few southern Utah locations where angling occurs for these fish, with positive comments made about their distinct appearance. If the project is implemented in fall of 2001, improved fishing could result at several locations by fall of 2003.

Complete eradication of brook trout has not always been achieved with past treatment projects when only a single application of rotenone was made (Table 1). Treatments planned under the proposed project include applications of rotenone on two consecutive years to increase the probability of completely removing brook trout. Experience on Boulder Mountain lakes and other treatment projects have shown that incomplete kills usually result from missing young trout that are still located in close proximity to spawning areas where there is an abundance of spring water. A second **treatment** after young fish have grown to larger sizes and moved outside of spawning areas is usually effective in making contact between the **remaining** fish and the toxicant.

In the past, native trout conservation projects often depended on transplanting a few hundred wild trout **per** year. Wild brood stocks of locally native trout from southern Utah have increased supplies of hatchery cultured native trout and allowed expanded conservation and sport fish programs for **Bonneville** and Colorado River cutthroat trout. Although **transplants** are still an important part of restoration efforts and are used to replicate specific wild populations, large numbers of native trout produced from wild brood stocks make larger projects possible. For example, larger drainages that include interconnected lakes and streams can now be considered for native trout restoration without requiring excessive amounts of time between removal of **nonnative** fishes and reestablishment of sport fisheries for native fish. In addition, hatchery production of sterile hybrids such as tiger trout and **splake** have added other options to native trout management. Even if sufficient numbers of native trout are not immediately available to restock renovated areas, sterile hybrids can be temporarily stocked for recreational purposes and can then be phased out as native cutthroat trout re-colonize areas and increase in abundance through natural reproduction. Also, the option exists to routinely stock limited **portions** of a drainage with sterile trout to satisfy sport fish recreational demands, while not jeopardizing native trout that occupy other parts of a drainage. Nevertheless, changes in management need to be implemented in ways to elicit support for native trout programs rather than opposition.

Additional native trout restoration projects on Boulder Mountain that are in progress include habitat improvements on Ranch Creek, the single stream with a remnant population of **Bonneville** cutthroat trout on Boulder Mountain (Wheeler 2000) and the expansion and protection of three remnant populations of Colorado River cutthroat trout on Boulder Mountain (Ottenbacher 1999). Also, transplants of Colorado River cutthroat trout were made into Dougherty Basin Lake and **Tall Four** Lake on Boulder Mountain, including a short section of interconnecting stream, in order to develop a wild brood stock of native trout. None of these projects, however, had or will have major impacts on popular sport fisheries.

The proposed Boulder Mountain project provides an opportunity to expand naturally reproducing native cutthroat trout into several lakes and streams, while at the same time improving sport fishing. We believe this is a positive and efficient management plan that does not require separate native and sport

fish management efforts, nor does it create conflict by replacing popular sport fisheries with native fish. The project will promote native cutthroat trout as an important sport fish and hopefully, create support for additional projects.

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Wild Trout VII

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